



MEMORANDUM FOR: SAF/PAS  
1690 Air Force Pentagon - 5D227  
Washington DC 20330-1690

MAY 30 2002

FROM: *Francis G. Hinnant*  
Francis G. Hinnant, Col, USAF  
Associate Director of Acquisition  
NPOESS Integrated Program Office  
8455 Colesville Rd, Suite 1450  
Silver Spring, MD 20910

SUBJECT: Paper approval for: NPOESS VIIRS VIS/IR Ocean Products

Enclosed are the required ten (10) copies of the subject papers. This paper will be released at the IGARSS02 conference on June 23, 2002. It was written by, and will be presented by employees of Raytheon Electronic Systems.

The program office has reviewed the information in the attached papers and found it appropriate for public disclosure without change.

Point of contact on this matter is Capt. Ken Speidel, NPOESS IPO/ADA at 301-427-2084 (Ext. 208).

Attachment: Presentation—10 copies

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VIIRS

## ***NPOESS VIIRS***

## ***VIS/IR Ocean Products***

**Dr. Peter S. Merheim Kealy**  
**Raytheon Information Technology and**  
**Scientific Services**

**06/23/02**

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# **VIIRS Ocean Products**

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## **Data Product**

## **Category**

<b>Sea Surface Temperature: bulk and skin</b>	<b>II/A</b>
<b>Precipitable Water</b>	<b>II/B</b>
<b>Remote Sensing Reflectance over the ocean</b>	
<b>Ocean Color</b>	<b>II/A</b>
<b>Net Heat Flux</b>	<b>III/B</b>

**Each data product, fully described in ATBD version 5, can be found at**

[www.ipo.noaa.gov](http://www.ipo.noaa.gov)

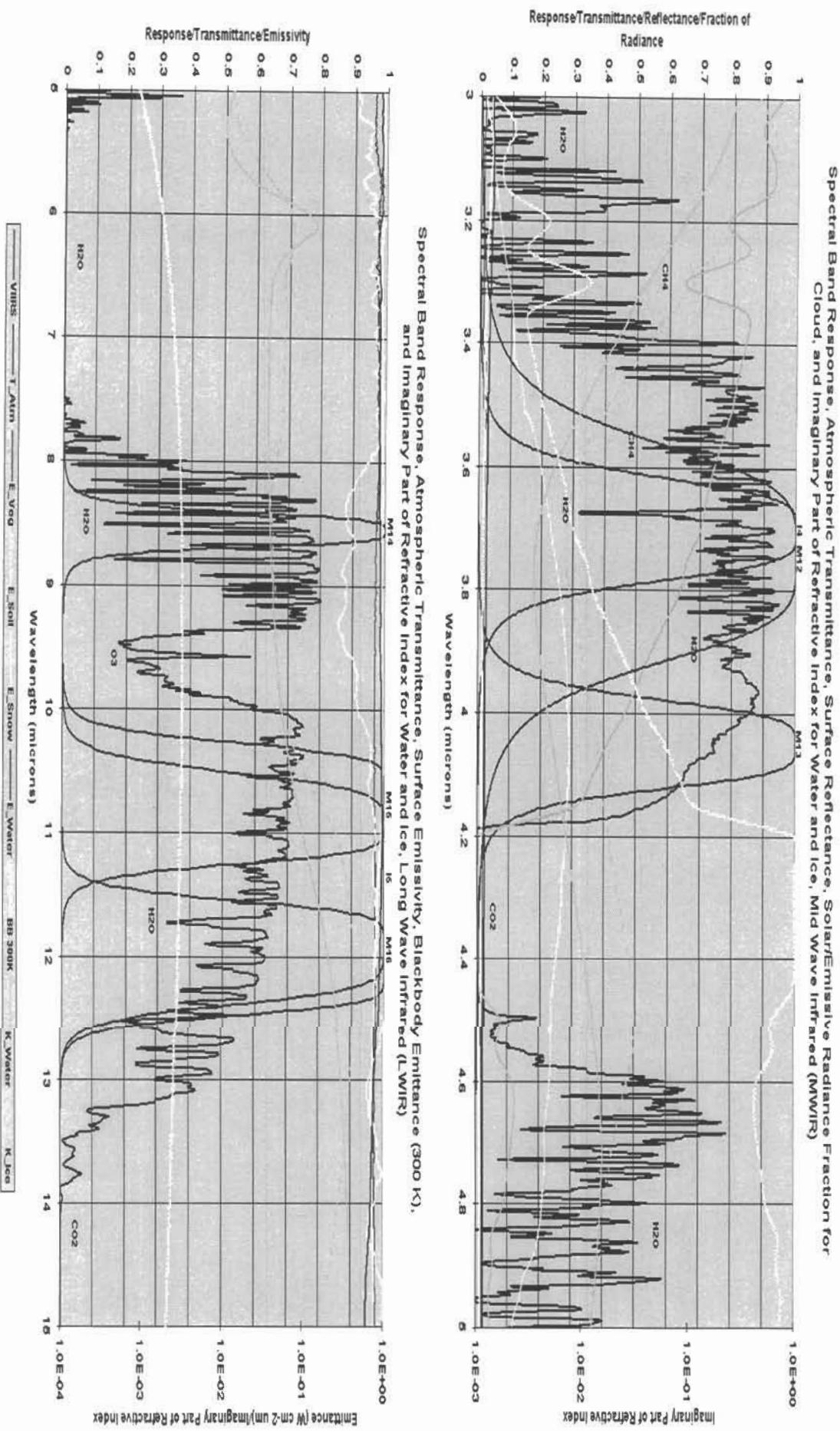
## Sea Surface Temperature Has a Broad Operational Need

- COBRA Applicability:
  - C4I Systems support (sonar/radar performance), ice/ocean analysis (fisheries/environmental management), navigation/trafficability (Gulf Stream, ice), general forecasting (long-range), climate/atmospheric monitoring (global change research), and weapon systems support (ducting, clutter, ASW).
- SST Algorithm Heritage
  - Dual Split-Window algorithm adapted from extensive MODIS/AVHRR heritage ( $3.7\mu\text{m}$ ,  $4.0\mu\text{m}$ ,  $10.8\mu\text{m}$ ,  $12.0\mu\text{m}$ ).
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- Authors: Richard J. Sikorski, Shawn W. Miller, Peter S. Kealy, William Emery
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ST Module Spectral Phenomenology VIIRS

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# SST Delivers Both Skin and Bulk SST

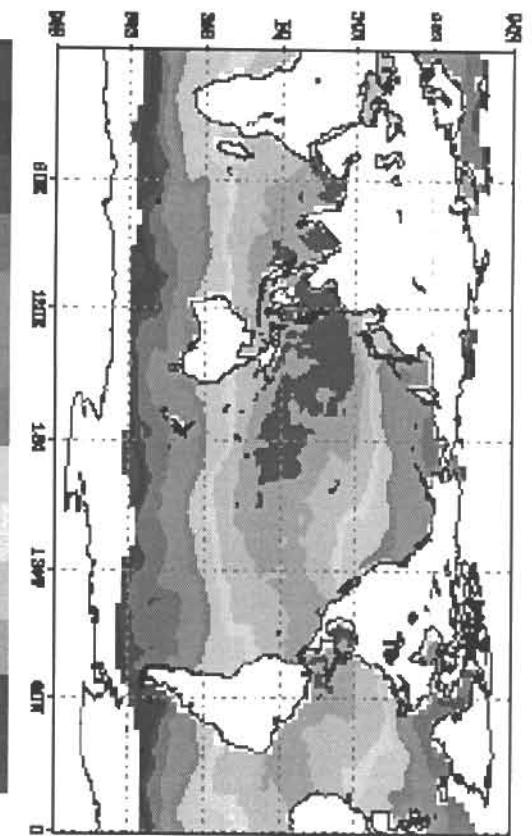
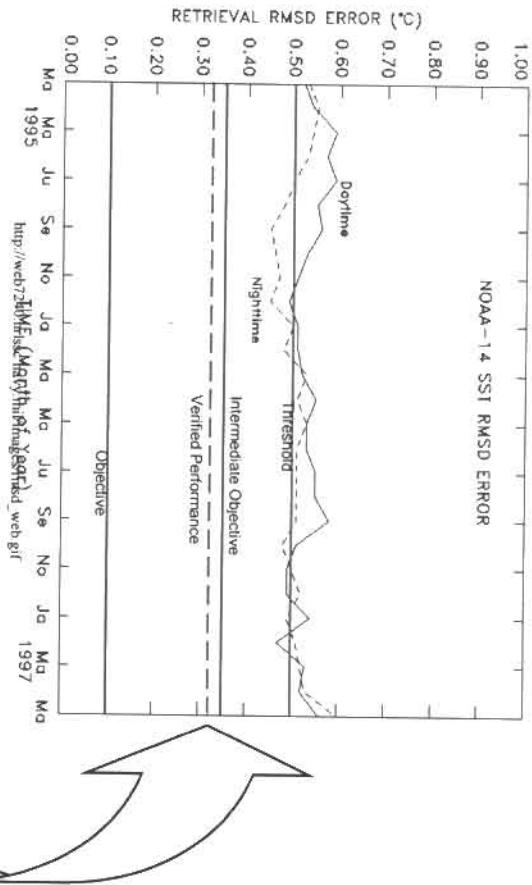
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- Day/night coefficient sets stratified for Cool atmosphere, Warm dry atmosphere, Warm moist atmosphere. Interpolation applied between these airmass classifications.
- MWIR corrected by VIIRS baseline dual split-window algorithm for solar reflectance. Both Skin SST and Bulk SST retrieved.
- Pixels that are contaminated by sun glint are not processed in MWIR. VIIRS fallback LWR split-window algorithm applied.
- Architecture extensible to include a skin to bulk conversion.
- Flexible architecture allows user selection of skin SST algorithm and bulk SST algorithm.
- One skin SST and one bulk SST delivered in SST EDR.

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## VIIRS SST Performance

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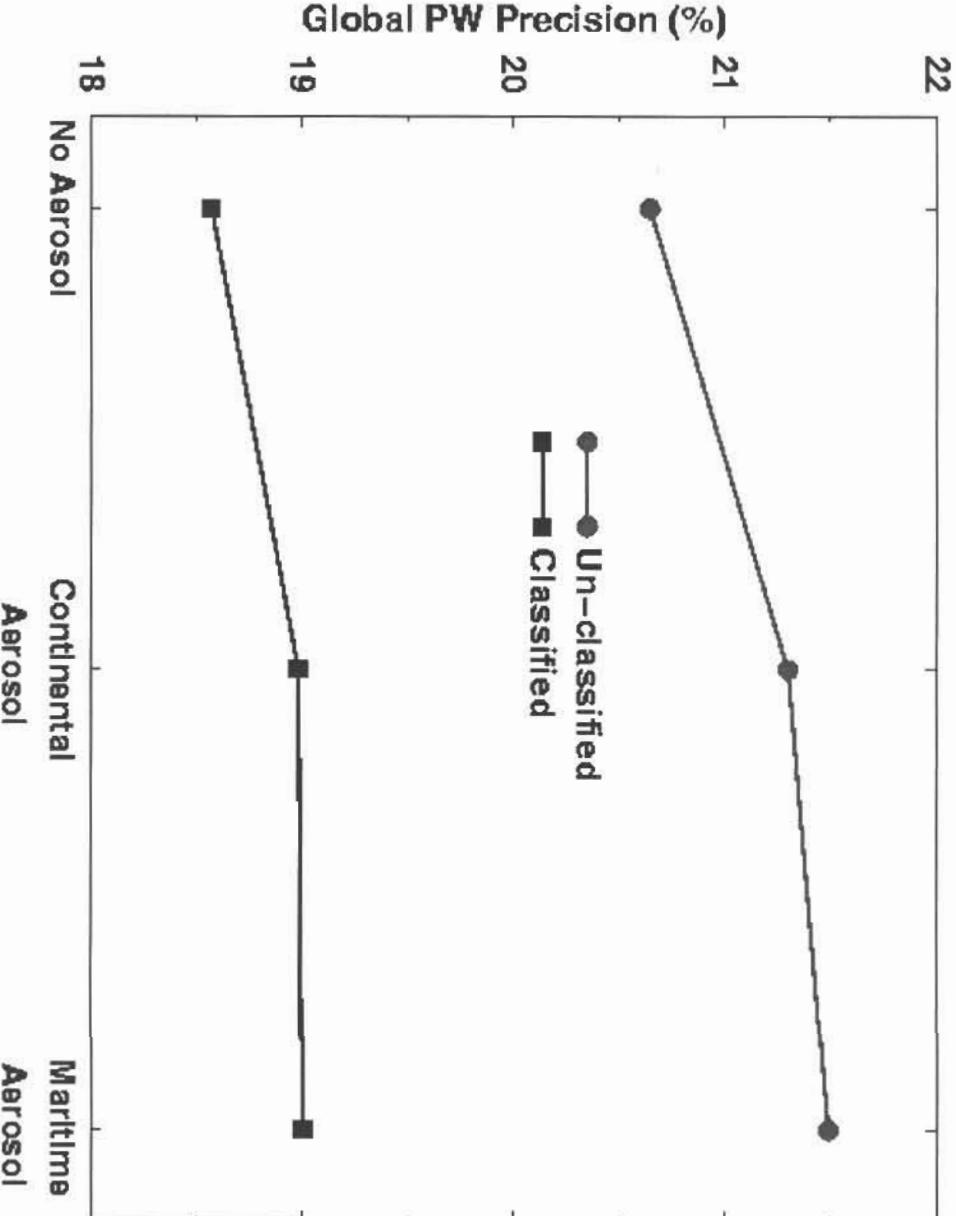


- VIIRS achieves specified performance, with margin,
  - at fine resolution, day and night,
  - for all temperature and zenith angle stratifications

# Precipitable Water: Why and How<sup>VIIRS</sup>

- COBRA Applicability:
  - Precipitable water is important to study the radiative balance of the atmosphere. Precipitable water along with cloud top height, cloud cover, and liquid water is crucial to climate studies particularly those focused on the radiative balance of the atmosphere.
  - General forecasting. This product is an essential component of NWP, short term weather forecasting and climate analysis
- Precipitable Water Algorithm Approach
  - Five band adaptation of Dual Split-Window algorithm ( $3.7\mu\text{m}$ ,  $4.0\mu\text{m}$ ,  $8.6\mu\text{m}$ ,  $10.8\mu\text{m}$ ,  $12.0\mu\text{m}$ ).
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# Precipitable Water Unit



**Classifying atmospheric characteristics improves PW retrievals**

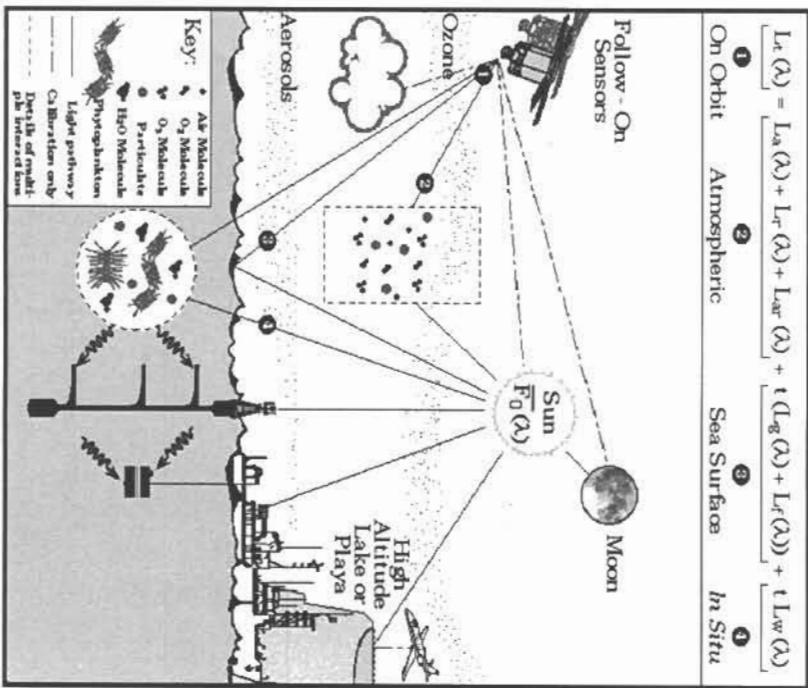
**SeaWiFS, MODIS Heritage**

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  - environmental quality conditions around coasts, indicator of currents, coastal erosion, distribution of biological activity (red tide algal blooms)
  - climate applications include estimates/indices of CO<sub>2</sub> sinks in the coastal marine areas
  - weapons systems support to anti submarine warfare
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# SeaWiFS and MODIS Push VIIRS Ocean Color Retrievals to Low Risk

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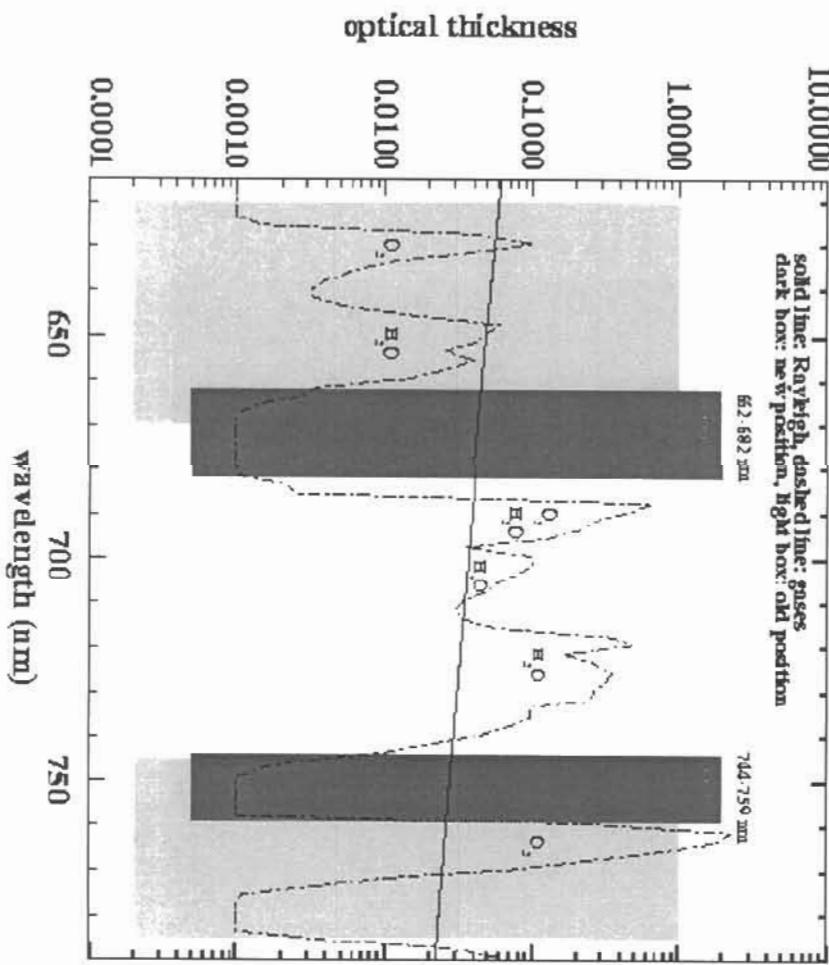
## SeaWiFS Methodology



## MODIS Chlorophyll from Indian Sub-continent

# VIIRS Bands Used to Process Ocean Color

$\lambda$ (nm)	$\Delta\lambda$ (nm)	Primary use
412	20	Dissolved organic matter (including Gelbstoffe), absorbing aerosols
445	18	Chlorophyll absorption
488	20	Pigment absorption (Case 2)
555	20	Pigments, optical properties, sediment
672	20	Atmospheric correction and sediments
751	15	Atmospheric correction, aerosol radiance
865	39	Atmospheric correction, aerosol radiance.



**Atmospheric correction bands  
positioned to avoid absorptions**

## Ocean Color/Chlorophyll EDR Algorithm has been Adopted from MODIS Heritage

- Semi-analytical algorithm based on a model of the remote sensing reflectance,  $R_{rs}(\lambda)$ , and empirical relationships.
- The model uses parameterization of phytoplankton pigment and gelbstoff absorption. The particulate matter backscatter is empirically related to  $R_{rs}(555)$  and  $R_{rs}(445)/R_{rs}(488)$ .
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- Inputs: remote sensing reflectances at 412, 445, 488, and 555 nm

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## Net Heat Flux Data Record

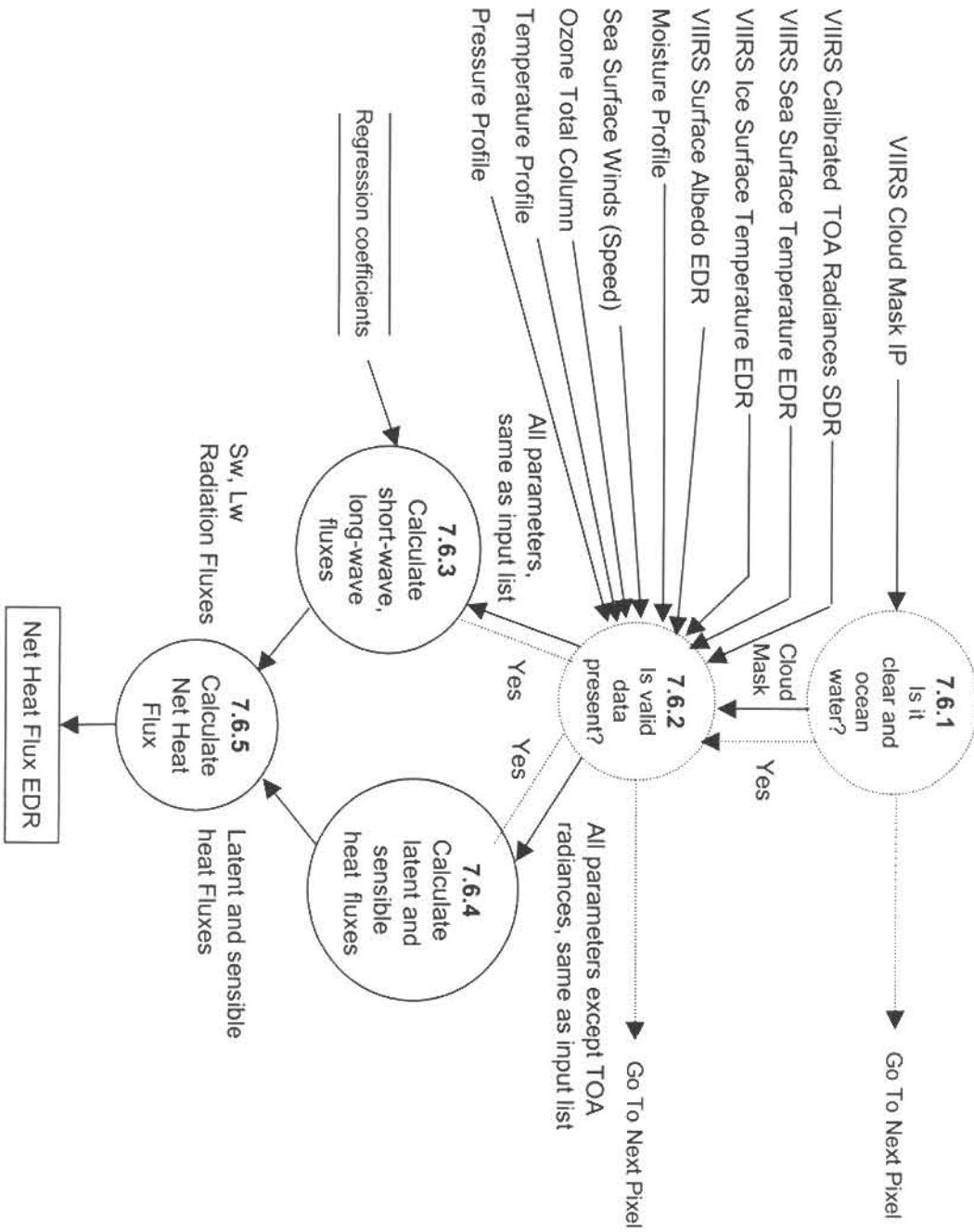
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  - Net Heat Flux = Snet - (Lnet - H - E)
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# Net Heat Flux EDR Performance Primarily Determined by Ancillary Data Quality

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## Ocean EDRs Summary

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- Direct heritage to MODIS and SeaWiFS, computationally fast, and easily implemented for global operation
- Quality flags designed to facilitate use as an operational product, allows user to build on MODIS heritage
- Additional potential applications include regionally tuned products, mass loading, ocean currents and coastal applications.

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## NPOESS VIIRS

CLEARED  
FOR OPEN PUBLICATION

VI/S/IR Ocean Products

JUN 21 2002 14

DIRECTORATE FOR FREEDOM OF INFORMATION  
AND SECURITY REVIEW  
DEPARTMENT OF DEFENSE

**Dr. Peter S. Merheim Kealy  
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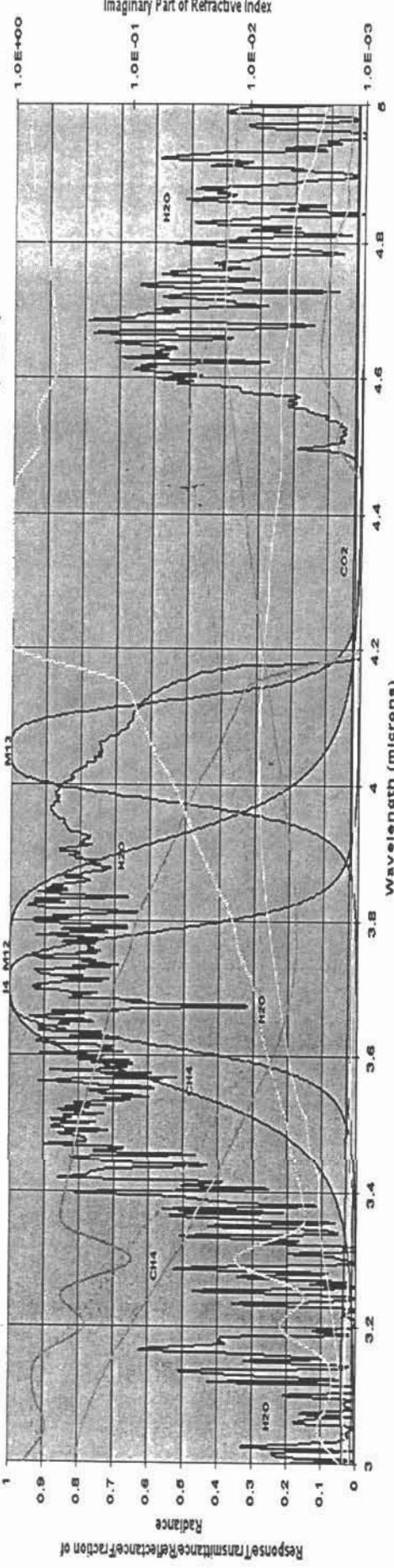
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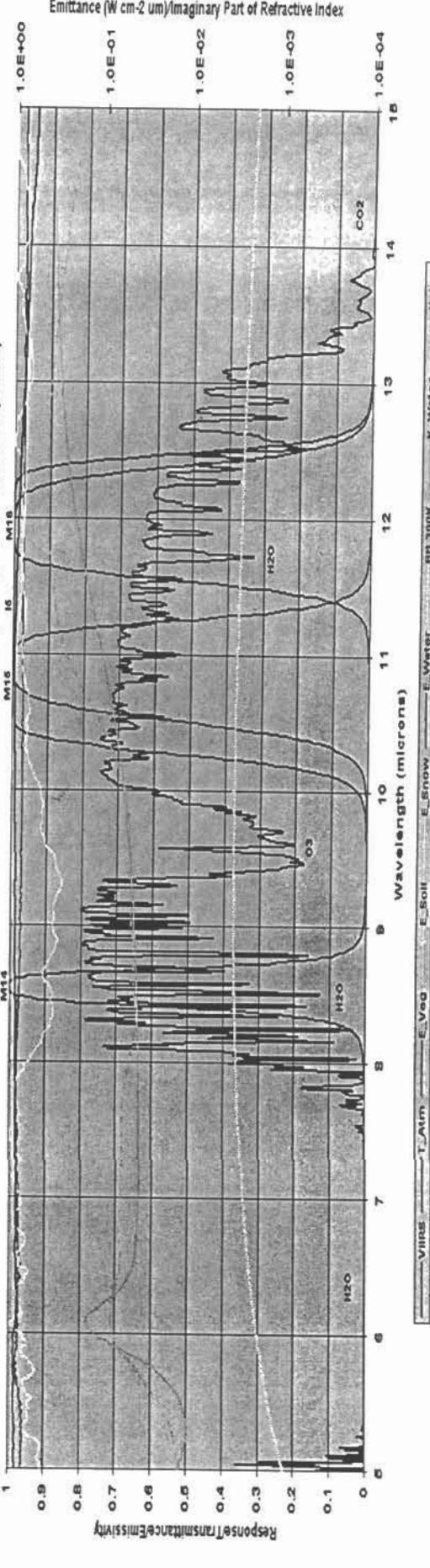
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# NPOESS ST Module Spectral Phenomenology VIIRS

Spectral Band Response, Atmospheric Transmittance, Surface Reflectance, Solar/Emissive Radiance Fraction for Cloud, and Imaginary Part of Refractive Index for Water and Ice, Mid Wave Infrared (MWIR)



Spectral Band Response, Atmospheric Transmittance, Surface Emissivity, Blackbody Emissivity (300 K), and Imaginary Part of Refractive Index for Water and Ice, Long Wave Infrared (LWIR)



## SST Delivers Both Skin and Bulk SST

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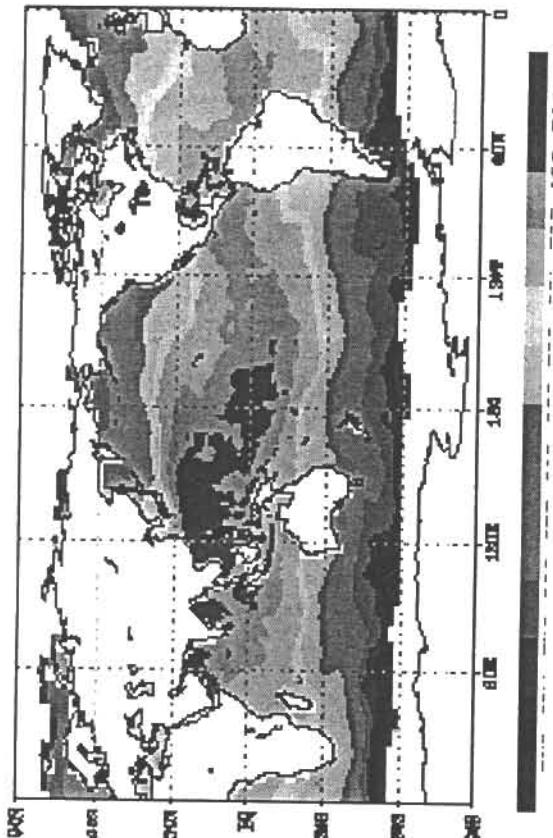
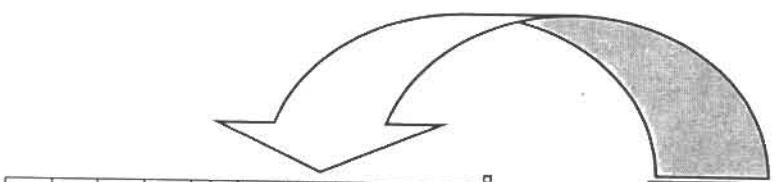
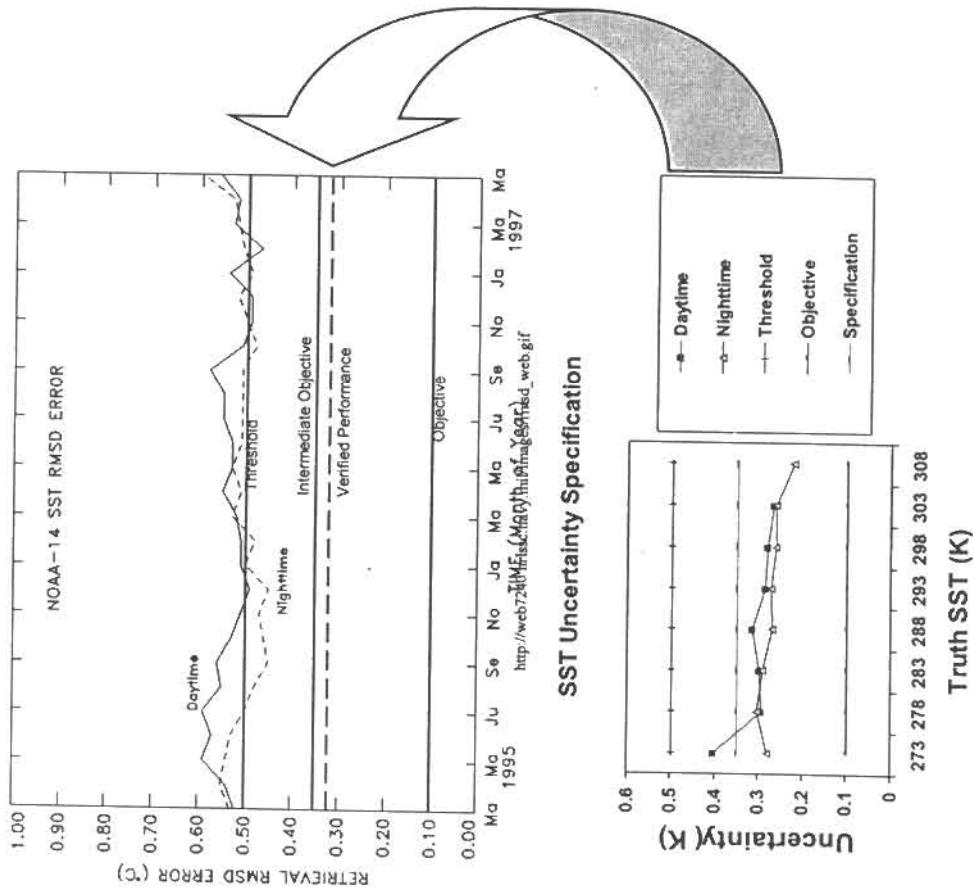
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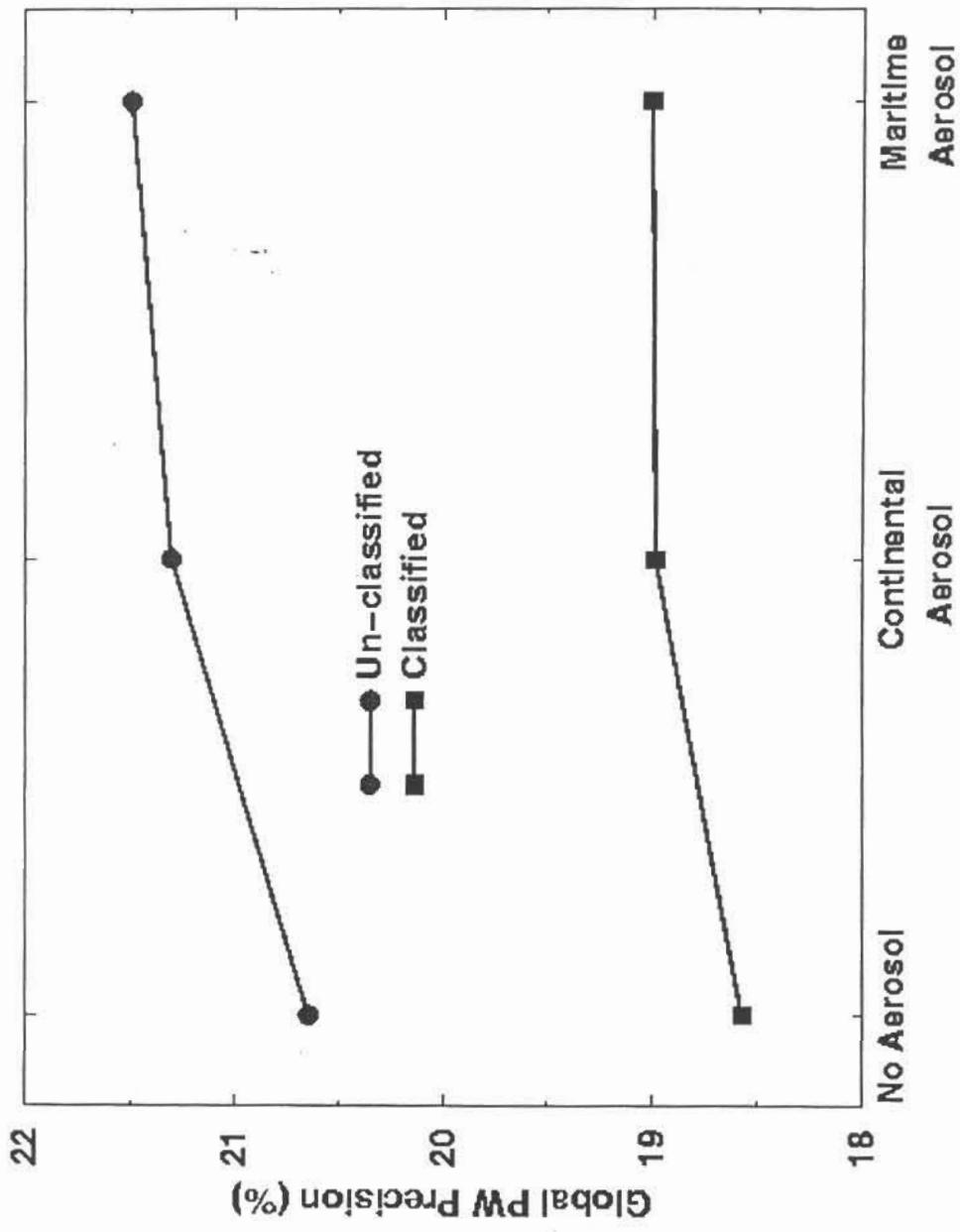


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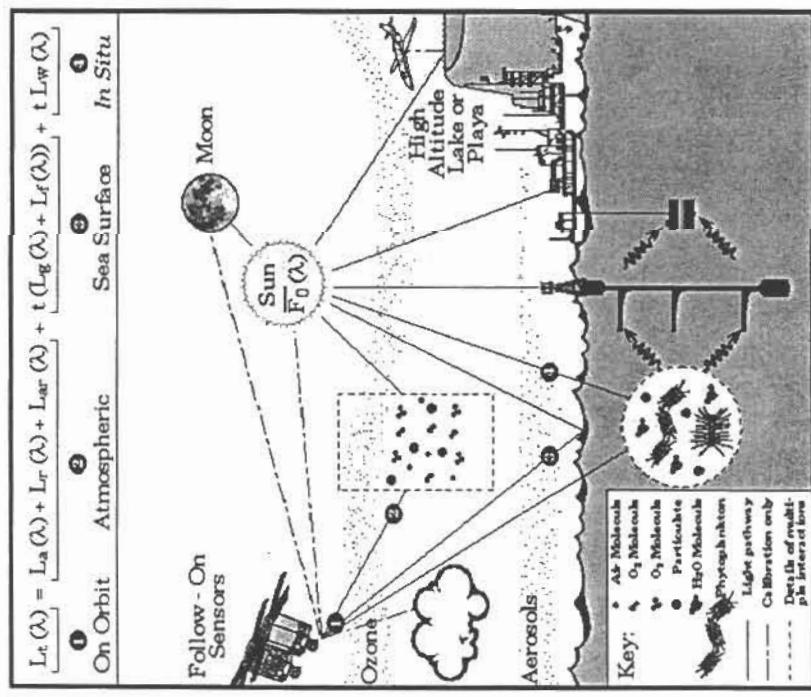
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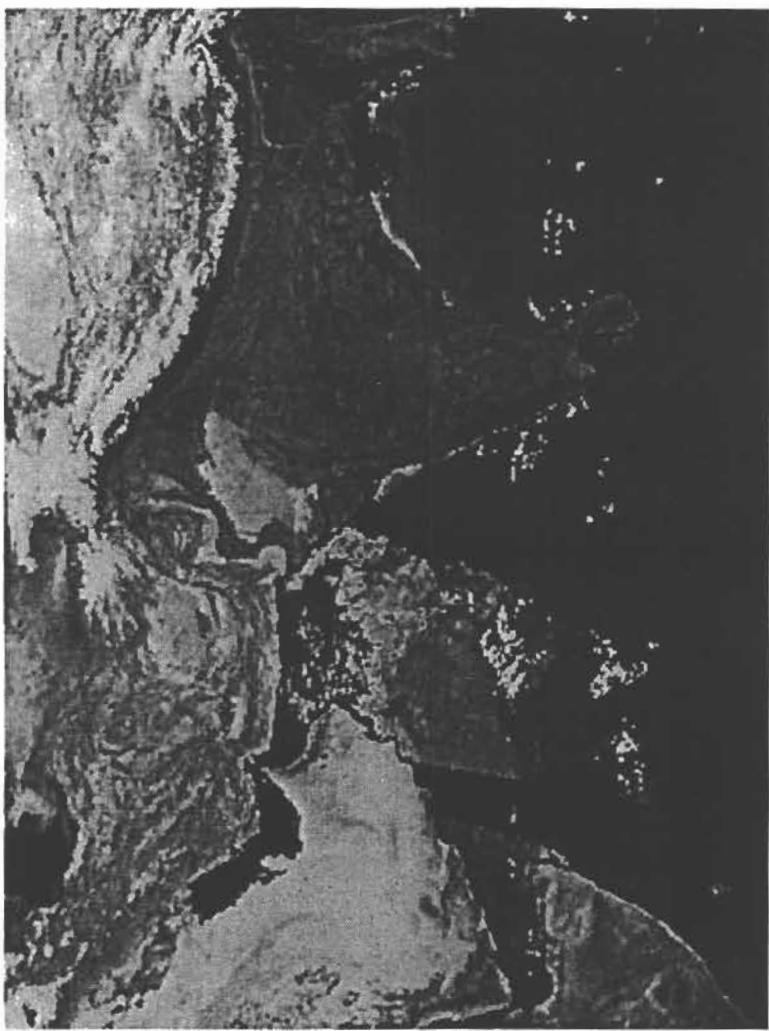
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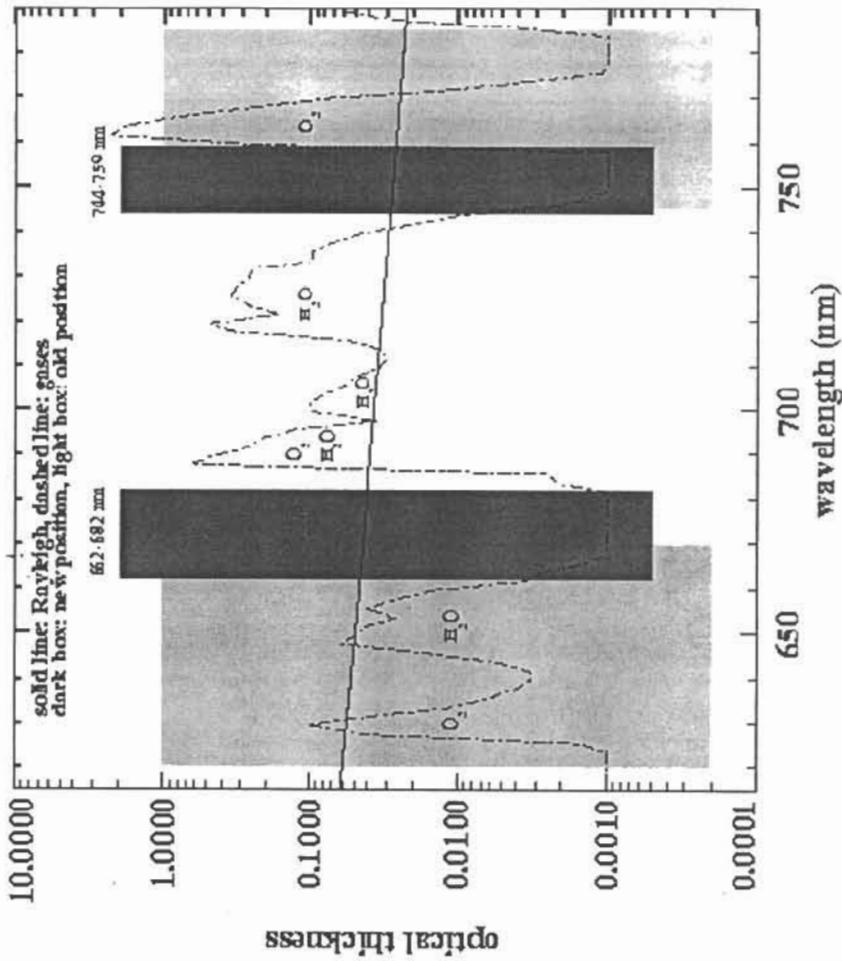


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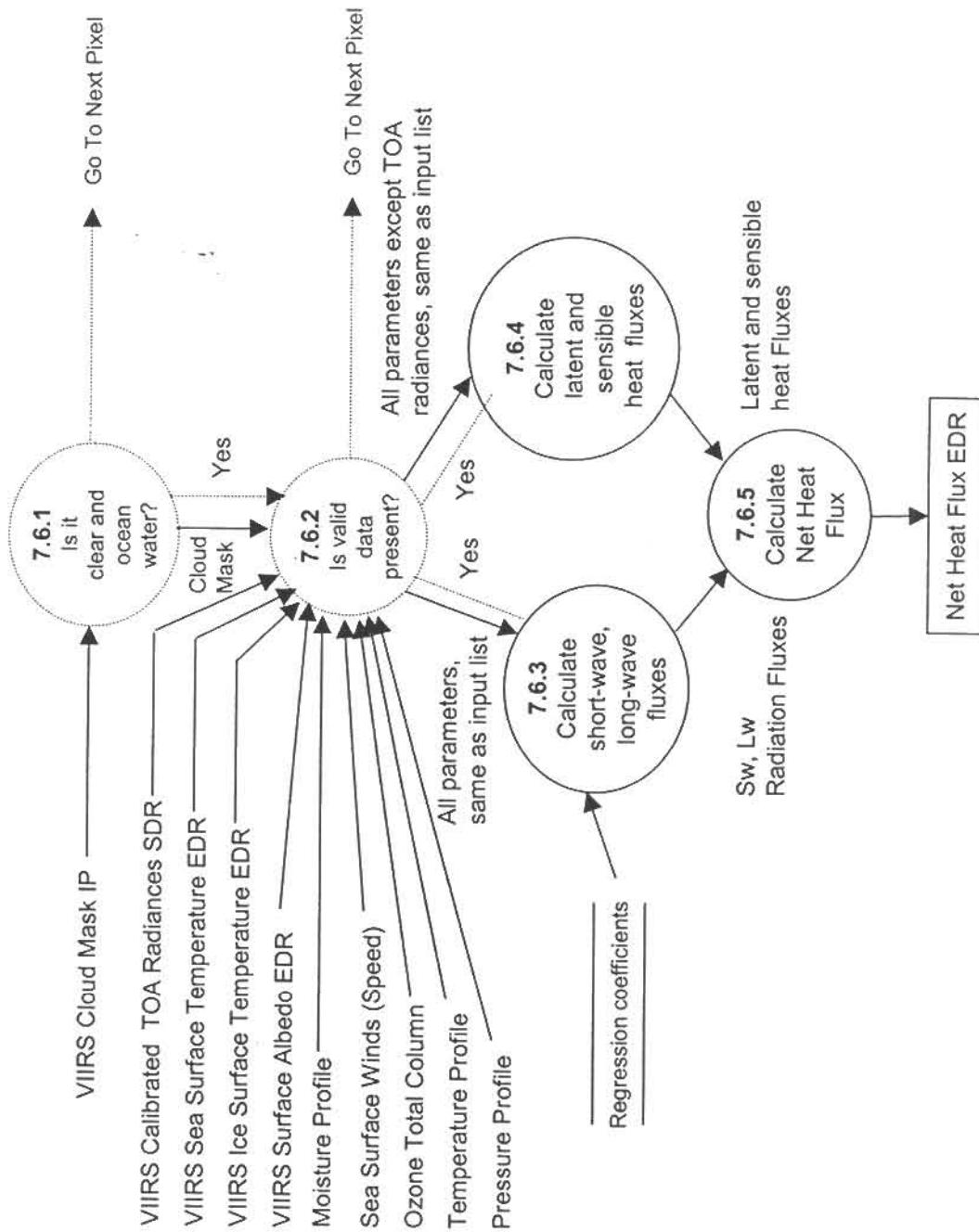
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